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IS 15429 (2004): Storage, Installation and Maintenance of DC Motors - Code of Practice [ETD 15: Rotating Machinery]

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Indian Standard

STORAGE, INSTALLATION AND MAINTENANCE OF DC MOTORS — CODE OF PRACTICE

ICS 29.160.30

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

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Price Group 3

Rotating Machinery Sectional Committee, ET 15

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Rotating Machinery Sectional Committee had been approved by the Electrotechnical Division Council .

This standard covers storage, installation and maintenance of dc motors.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard
STORAGE, INSTALLATION AND MAINTENANCE OF DC MOTORS — CODE OF PRACTICE

1 SCOPE

This standard covers storage, installation and maintenance of dc motors.

2 REFERENCES

The following standards are necessary adjuncts to this standard:

IS No.	*Title*
732 (Part 2) : 1983	Code of practice for electrical wiring insulation : Part 2 Design and construction (*third revision*)
900 : 1992	Code of practice for installations and maintenance of induction motors (*second revision*)
1885 (Part 35) : 1993	Electrotechnical vocabulary: Part 35 Rotating machines (*first revision*)
3043 : 1987	Code of practice for earthing (*first revision*)

3 TERMINOLOGY

For the purpose of this standard, the definition given in IS 1885 (Part 35) shall apply.

4 HANDLING OF MOTORS AT SITE

4.1 Read carefully the manuals, final test report and deviation, if any supplied by the motor manufacture for handling motors.

4.2 Motors should be handled very carefully to increase their life and service. The following basic precautions should be taken in handling the motors:

a) Always follow the lifting arrangement as specified in manual;
b) For motors, which are to be assembled at site, follow the instructions supplied by the motor manufacturer for handling various components of the motors;
c) Do not use shaft extension for dragging the motor;
d) Do not roll or drag the motor on the floor; and
e) Avoid jerks and jolts to motors as it may damage the bearings and effect its life.

5 STORAGE OF MOTORS

5.1 All motors shall be stored in a proper storage which is essentially clean, well ventilated, dry adequate light and have adequate provision for safe lifting handle of the equipment.

5.2 The machined parts which have a protective coat of any rust preservative should not be taken off during normal storage periods. In case of long storage, periodic inspection 6 motors should be carried out and fresh preservation should be applied, if required, after anti-rust coat or moisture has been removed. Preservation can be easily taken off by using paraffin or solvent suggested by motor manufacturer.

5.3 The packing boxes, if received in proper condition should be stored as it is. The packing boxes which are broken, should be inspected carefully for any damage of equipment or any part of the equipment. If possible, the inspection should be carried out in presence of the equipment manufacturer.

5.4 Special precautions should be taken when the machine in idle for considerable period to avoid corrosion of the bearings and loss of grease. It is advisable to rotate the shaft periodically as the grease tends to settle at the bottom of the housings. Before a machine is started after a long idle period, the bearings covers should be removed and grease in the housing pressed with thumbs between the races of the bearing. If any deterioration of grease is apparent, the old grease should be removed and new grease pressed in the bearing housings.

5.5 The electrical machine is fitted with an anti-condensation heating system. The system is so designed that the temperature of active parts of the machine is always higher than the ambient temperature and that condensation is prevented. It is also called space heater. If equipment is not to be used for long duration, it is always better to connect the space heater to the required supply.

6 INSTALLATION

6.1 Exchange of Information

6.1.1 The electrical engineer responsible for installation of equipment covered by this code shall be informed, by the persons requiring the equipment, as to its exact duty (ies), location and conditions under which it is expected to operate . This information should, if possible, be exchanged before the construction of the building and before any electrical equipment is ordered, thus enabling the electrical engineer to detail any special building features required and to specify the most suitable type of equipment for the operational requirement involved.

6.1.2 Details of the electric supply available and of any special requirements regarding the ratings of equipment and the conditions under which the equipment may be connected to the supply should be ascertained from the supply authorities.

6.2 General Requirements

6.2.1 *Compliance with Indian Electricity Rules and Other Regulations*

All electrical installations shall be checked for compliance with the requirements of the current Indian Electricity Rules and Regulations that may be applicable. It is recommended that the local authority concerned in the administration of the Rules and Regulations in the matter of the layout of the installation of industrial motors and their controlgear be consulted to ensure that the requirements under the rules and regulations are complied with.

6.2.2 All electrical installations shall be carried out by persons competent to undertake such work under the regulations that may be force in different states.

6.2.3 *Earthing Connection*

The frame of every motor and its associated controlgear shall be earthed by two separate and distinct connections with earth through an earth electrode. Where practicable, the earth connections should be visible for periodical inspection.

6.2.4 Earthing shall be done in accordance with IS 3043.

6.2.5 All wiring shall be done in accordance with IS 732 (Part 2).

6.3 Installation Design

6.3.1 *General*

The construction of all apparatus shall be such that operating temperatures of components do not exceed the safe figures laid down in the relevant Indian Standards having regard to the conditions in which the equipment is used. The equipment shall be installed, operated and maintained as to ensure that such safe temperature are not exceeded.

6.3.2 *Electrical Protection of Circuits and Apparatus*

All apparatus and associated cable-work shall be protected at the origin of the circuit against the effects of electrical faults in that circuit by a suitable automatic protective device. Such a protective device may be in the form of a circuit-breaker or fuse of adequate breaking capacity to deal with the effects of any likely alterations or extensions to the installation. Auxiliary light current circuits shall have separate fuses.

6.3.3 Where medium voltage wiring is enclosed in conduits, the ends of the conduits shall be securely fastened to the motor terminal box and to the terminal box of the control gear and other switches used in connections therewith.

6.3.4 When the motor is mounted on slide rails, for adjustment of bolt tension, rigid conduit shall not be connected to the motor terminal box but flexible metallic conduit with approved adapters shall be utilized for final connection to the motor keeping good electrical and mechanical continuity throughout with metal-to-metal joint between solid conduit and flexible tube. The ends of the conduit shall be fitted with some suitable type of bushing to protect the insulation of the cable from damage.

6.3.5 *Isolation of Equipment*

Each motor and a group of motors and associated control gear shall have means of disconnection from supply means shall be so placed as to be readily accessible from the position danger may arise.

6.3.6 While making provision for isolation due regard should be paid to the necessity for isolating all control, pilot and inter-locking circuits where these are derived from the main source of supply or independently. The principle to be observed is that any device which purports to isolate an installation should do so without exception. If it is not practicable to carry out complete isolation with a single device, clear instructions shall be affixed to the apparatus in a permanent manner setting out the procedure to secure complete isolation.

6.4 Installation Work

6.4.1 *General*

Where the magnitude of the installation justifies the cost, a set of record plans shall be provided by the installation engineer or contractor, clearly indicating the complete layout of the installation.

There is always the possibility that hair, hands or clothing of persons may be caught in moving parts of electrical devices which should therefore, be so located or guarded as to minimize the risk of such injuries. In the case of equipment, subject to the provisions of *the Indian Factories Act*, such mechanical protection is statutory requirement.

All equipment shall be carefully unpacked and checked against the advice notes received from the manufacturer to ensure that there has been no loss or damage during transit. The rating plate details shall be checked for the requirements of purchase order. The motor or control gear or any other equipment, connected with the operation of the motor, when received, shall be carefully checked to ensure that everything is in proper condition so that the installation work may be proceeded without interruption.

6.4.2 *Location of Motors and Control Apparatus*

6.4.2.1 Apparatus shall be so located that all current carrying parts are adequately ventilated to avoid losses due to non-dissipation of heat.

NOTE — In no circumstances should a motor be enclosed in a box or other covering that restricts or excludes the ventilating air to a significant extent. Such restriction may result the burning out of the motor when a sustained load reached the full value.

6.4.2.2 The motor and control apparatus shall not be located where they are liable to exposure to water, corrosive liquid, oil steam, carbon metallic dust, dirt or other adverse conditions or to risk of mechanical damage, unless they are suitably enclosed to withstand such conditions.

6.4.2.3 Adequate access shall be provided to all working parts. The possible need for facilities for removing the equipment at a later date for repairs or maintenance should be considered in relation to the accessibility of the equipment.

NOTE — For handling heavy equipment, it is often advisable to arrange for the incorporation of a lifting beam in the structure of the building, the beam being located immediately over such parts of the equipment as may require attention and being capable of supporting the maximum weight involved.

6.4.2.4 The placing of apparatus in situations when inflammable materials may be present should be decided in relation to the fire risk involved, and where it is impracticable to segregate the apparatus from such material, the use of the flameproof apparatus should be considered.

6.5 Cleaning of Machine Parts (Paints Coating)

All machined surfaces of machine parts as well as small parts, such as, screws, bolts keys, feather-keys set pins, etc, are provided with anti-corrosion coating in the works. Carefully remove this anti-corrosion coating before starting erection. *See* Operation and Maintenance manual of equipment manufacturer.

Wash off the anti-corrosion coating on the machined surfaces of machine parts and other small parts with the help of kerosene or similar agent.

After removal of anti-corrosion coating, dry surfaces thoroughly and then apply a thin film of oil, otherwise the surface may rust.

NOTE — Do not use metal tools for removing the anti-corrosion coatings, such as scrapers, knives or sheet-steel strips.

6.6 Foundation and Levelling

See **11.3** of IS 900.

6.7 Mounting of Coupling and Alignment

See **11.5** and **11.6** of IS 900 or as mentioned in Operation and Maintenance manual of the equipment manufacturer.

6.8 Insulation Resistance

See **11.4** of IS 900 or as mentioned in Operation and Maintenance manual of the equipment manufacturer.

7 CHECKS BEFORE COMMISSIONING

7.1 General

All equipment shall be inspected and tested by competent person before being actually put into service.

7.2 Mechanical Checks

See **12.2.7** of IS 900.

7.3 Electrical Checks

7.3.1 The terminal markings of motors shall be checked for conformity with the drawing supplied by the motor manufacturer. Before connecting it to the mains, all connections shall be checked with the wiring or the circuit diagram applied.

7.3.2 All fixed connections shall be checked for tightness.

7.3.3 The rating of fuses shall be checked.

7.3.4 The main and looped earth wires shall be continuous. To ensure this, all earth connections shall be checked for tightness and the earth resistance shall be measured and recorded.

8 COMMISSIONING OF MOTOR

Before the equipment is put into service, the following shall be checked.

8.1 Stator/Magnetic System

a) Check pole connections / continuity check,
b) Check the bolted connections at the joints of stator and brush gear for tight fit,
c) Examine the condition of the terminals (uncleaned parts to be cleaned/repaired), and

d) Measure the insulation resistance of reach stator winding against the machine frame and against neighbouring windings. Where the insulation resistance is low check for surface tracking / clean / dry the motor.

8.2 Rotor/Armature

a) Check the smoothness of commutator surface, mica under cutting and chamfering, and
b) Measure the insulation resistance of rotor winding. Where the insulation resistance is low, check for surface tracking / clean / dry the motor.

8.3 Brush and Brush Gear

a) Check the brush gear with respect to its position in the neutral zone,
b) Check the tightness of the brush holders on the rockers arm, and
c) Check that all brushes have contact with commutator surface.

8.4 Bearings

a) If ball and roller bearing motors have been kept idle for more than six months, whether new, spare or used motor, that bearing covers shall be removed for inspection of grease. If it is found that grease has a skin over the surface, the bearing shall be washed thoroughly in petrol to which few drops of oil have been added. The bearing housings shall be re-packed with new grease of the grade and quality recommended by the motor manufacturer, care being taken that the balls or rollers will not churn in the grease. One of the chief function of the grease is to prevent the entry of dust into the bearings, in addition to lubrication.
b) Check the bearing surfaces for contamination and the oil rings for roundness and correct position.
c) Check the sealing ring or insert-type seals for correct mounting. Check the oil tubing (where provided) for correct mounting and satisfactory condition and the valves and fittings for correct arrangement.
d) Check the bearing insulation for proper location. Measure the insulation resistance.
e) Check the oil filling on the sight glass.
f) Check that the oil system of forced-lubricated bearings is filled with oil.
g) Check the oil pumps for satisfactory operation and the direction of flow.
h) Check the connection for leaks. Check the correct flow rate and pressure.
j) Check the hydrostatic lubrication system (if provided). The pressure should build up immediately when the jacking pumps have been started and drop slightly when the shaft have been raised. If necessary, check that the shaft has been raised, using a dial gauge.

8.5 Accessories

a) Check the embedded resistance thermometers for correct connection and functioning.
b) Check anti-condensation heater for proper fitting, healthiness of leads and proper functioning.
c) Check the condition of air filters (where provided), and
d) Check the cooling water piping for correct installation and condition (where provided).

8.6 Coolers

a) Open the vent valves. Fill the pipe with clean water. When water emerges from vent valves, close the valves. Check the connection for leaks.
b) Vent the coolers, keeping the valves open until water comes out when the air has escaped.
c) Check the fans for correct direction of rotation.

8.7 Fans

a) Check the separately driven fans (where fitted) for satisfactory operation (direction of rotation) and the air flow.

9 STARTING UP

a) Switch off anti-condensation heater.
b) Start the oil pumps (if provided) and fans and check for correct operation.
c) Apply the full excitation current to the motor, switch on the motor for a short period and stop it again. Check the noise, proper running of motor and lubrication.
d) When the motor runs satisfactorily, apply the full excitation power and accelerate the motor at a low rate while observing the commutation. If heavy sparking is observed, determine the cause and remedy the disturbance.
e) Accelerate the motor slowly and check for noise, mechanical running properties and lubrication. If uneven running or abnormal noise is noticed, shut down the motor and determine the cause of the disturbance while the motor is coasting. If running smoothness is improved immediately after switching off, the disturbance is due magnetic or electrical causes. The fact that the running characteristic is not improved after switching off points to mechanical trouble, for example unbalance on the electrical or driven machine or misalignment. Analyse the cause and remedy the same.
f) Check the direction of rotation of the motor. In

case motor runs in the wrong direction, change the armature leads.

g) If everything is found satisfactory, increase the speed slowly, waiting for some time on each step for the motor to accelerate. When motor reaches full speed, observe that there are no excessive vibration and noise and that the drive is running smoothly.

9.1 Failure to Start

a) If motor fails to start, check the connections for correctness in accordance with the diagram supplied.

b) Check the presence of voltage at the starter terminals (make sure that no section main switch is open and there are no blow off fuses on the motor circuit).

c) All connections are tight, and there are no bad contacts in either cabling or control circuits.

d) After this inspection, if everything is found satisfactory, another attempt should be made to start the motor. If the motor do not start, the driven equipment should be uncoupled from the motor and fresh attempt made to start the motor.

e) When the motor runs upto full speed, load may be applied to the driven machine.

9.2 Failure to Take Load

If direction of rotation is correct and motor runs satisfactory while it is not loaded, but trips out when load is applied to the driven equipment, a check should be made that the overload trips are correctly set. A check should also be made that the load is not excessive. It is also recommended to check that no tight points has developed in the drive under loading conditions. If it is found that the motor still refuses to run at load, the manufacturer of both the motor as well as driven equipment should be consulted.

10 MAINTENANCE AND PERIODICAL CHECKS

10.1 General

Careful maintenance and inspection permits any defect to be detected and corrected at an early stage before they are able to develop into serious damage. Maintenance and inspection thus help to preserve the machine in good running condition, avoid expensive repair cost and breakdown of the mill and thus increase the reliability and availability of the machine.

Guidelines given in the Operation and Maintenance manual by the equipment manufacturer, should be strictly followed for few inspections and then the equipment user should make their own schedule of inspection (daily, weekly, fortnightly, monthly or yearly) based on their own experience, production schedule, product profile, etc. However the inspection of parts as recommended by equipment manufacturer must be adhered too. It is not necessary that every part is inspected daily or fortnightly. The motor parts which are more sensitive (for example carbon brushes and electrical joints) and having greater effect on production, should be inspected frequently. Other parts may be inspected after longer duration. All accessible parts of the motor should be inspected visually after about 500 operating hours.

Deviations from normal operating conditions over prolonged periods, for example, atmospheric conditions, demand in change of speed or overload condition of motor for certain product profile, which is not within agreed specifications) indicate a reduction of the operating reliability of the plant. To avoid damage, the causes should be identified and any defects remedied as soon as possible.

10.2 Alignment of Motor

a) Check the foundation for settling or cracks. Check rotor alignment and bending tendency of shaft. Re-align the bearings (pedestal bearings) or motor with end-shield bearings, if necessary.

b) Check the air gap and axial offset and compare the values in the "Erection card". Re-align the stator, if necessary. This is valid for motor with pedestal bearings.

10.3 Machine Anchors and Fixing Elements

a) Check all foundation anchoring elements for tight fit.

b) Check all fixing bolts and screws of the machine parts, including taper pins and washers, for tight fit. Re-tight, if necessary. For locking only use new locking elements.

10.4 Condition of Coupling

a) Check all coupling (rigid) bolts and locking elements for tight fit. Re-tight, if necessary. Use new locking elements. Inspect coupling bolts for fretting corrosion.

b) Check the keys and associated locking elements for tight fit in case coupling with tangential keys. If necessary, drive in the wedging elements and fit new key locks. Use new locking elements. Inspect for fretting corrosion.

c) Check to see that coupling (toothed coupling) housing can be shifted axially should this not be the case, clean the coupling and check alignment of the machine.

Clean the oil-filled coupling and check its condition. Clean the oil-lubricated coupling and check its condition.

d) Check the axial clearance (flexible coupling). Check the pins for tight fit and re-tighten, if necessary.

10.5 Motor

10.5.1 *Stator/Magnetic System*

a) Check fixing elements of the poles and pole-winding supports for tight fit. Re-tighten, or fit new wedges, if necessary. Use new locking elements.
b) Clean all the main, inter (commutating) poles, compensating and any series winding, as well as the spaces between the windings.
c) Check soldered connections between compensating bars and conductors. Check compensating bars for tight fit in the slots.
d) Check insulation resistance of main poles and armature circuit, between windings and earth.

10.5.2 *Rotar/Armature*

a) Clean the entire armature windings and ventilation ducts, inspect windings for oil film and carbon dust deposits.
b) Check condition of armature winding insulation.
c) Check armature slot wedges for tight fit. Check bandaging for tightness and proper condition on armature.
d) Check condition of connections on armature windings and equalising circuit.

10.5.3 *Brush and Brush Gear*

a) Check the free movement of brushes in the brush holders.
b) Clean the commutator surface. It should be bright, free from ribbing and have a uniform skin. Check the commutator surface for mica undercut and chamfering.
c) Check the tightness of the brush holders on the brush holder arm. Check the gap between brush box and commutator surface. It should not be more than 2.5 mm.

10.5.4 *Machine Pit*

Inspect the stator pit and machine for signs of incipient damage. If necessary locate the defect and take the necessary measures.

10.5.5 *Motor Coolers*

a) Clean the cooler. Determine the cleaning intervals according to the degree of contamination. Inspect corrosion protection.
b) Replace and clean the air filters.

10.5.6 *Oil Supply System*

a) Check the oil supply system for correct functioning.
b) Clean the oil filter. Determine the cleaning intervals according to degree of contamination.

10.5.7 *Monitoring Instruments*

Check the monitoring instruments and contact devices for paper functioning check the calibration.

10.5.8 *Bearings*

a) *Ball and roller bearings*
   Clean the bearings and inspect for their healthiness. Replace, if necessary, Re-grease with required quantity of grease.
b) *Rolling bearings*
   1) Clean and inspect the bearing insulation and the insulation of the pipe and thermometer connections. Replace the insulation, if necessary.
   2) Re-lubricate the rolling bearings with required quantity of new grease or oil. Clean and inspect the bearings and replace, if necessary.
c) *Sleeve bearings*
   1) Clean and inspect the bearings insulation and the insulation of the pipe and thermometer connections. Replace the insulation, if necessary.
   2) Check the radial and axial play and compare the value supplied by equipment manufacturer. Inspect the bearing surface.
   3) Check shaft lift and oil supply system.

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